

PARTIAL ENGLISH TRANSLATION OF JAPANESE LAID-OPEN  
PATENT APPLICATION NO.2002-021773 (PART OF  
PARAGRAPHS 0023-0024 & 0046-0047):

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[0023]

... As the first magnetic coupling,  
abnormality detector 57 for monitoring the electric  
magnet current, a circuit 100 as shown in Fig. 7,  
10 for example, is suitable. Fig. 7 is a block diagram  
showing an example of a circuit for detecting  
impeller step-out (magnetic bearing coupling step-  
out) used by the centrifugal liquid pump of the  
present invention.

15 [0024]

The circuit 100 monitors current values  
such as I1, I2, and I3 of electric magnets (three  
magnets according to the embodiment) that are  
included by the centrifugal pump for magnetic  
20 bearing. The current values are added by a first  
operational amplifier. It is considered abnormal if  
the total is less than a threshold value D  
(specifically, if the output of a second operational  
amplifier is H). Here, the magnetic coupling  
25 abnormality detector is not limited to what is  
described above; but may be configured such that it  
is determined abnormal if any one of the current  
values is less than a threshold value, or if two or  
more values are less than a threshold value. Further,  
30 it does not have to be an analog circuit as above;  
but may be digitally configured. Further, the  
information on which the abnormality determination  
is made is not limited to the total of the current  
values; but the information may be a total of the  
35 current in a given period, an average for a given  
period of the current value total, or an average of  
the current in a given period. ...

[0046]

... Fig. 22 is a block diagram showing an example of the magnetic bearing abnormality (electric magnet current abnormality) detector used by the centrifugal liquid pump of the present invention.

[0047]

This circuit 170 monitors current values (I1, I2, and I3) of the electric magnets (three according to the embodiment here) that the centrifugal pump includes for magnetic bearing. If the total of the current values is greater than a threshold value -C, it is determined abnormal. Specifically, the current values (I1, I2, and I3) are added by the first operational amplifier, and the total is compared with the threshold value -C by the second operational amplifier. If the output of the second operational amplifier (which outputs H if an input value is less than a threshold value) is L, it is determined to be abnormal. Here, the magnetic coupling abnormality detector is not limited to the circuit described above; but the abnormality can be detected by determining whether any one of the current values is greater than the threshold value, or two or more of the current values are greater than the threshold value. Further, it is not limited to an analog implementation, but a digital implementation is possible. Further, as for the current value serving as determining information used by the magnetic bearing current abnormality detector, a total value of the current in a given period, a total average of the current in a given period, and an average value of the current in a given period can be used. When the total average of the current in the given period is used, a digital process is used. If the average value of the current in the given period is used, an analog

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implementation using a low pass filter, and a digital implementation are possible.